Looking Down the Road — Transportation Technologies Research at Argonne

Challenges

Energy and the Economy: The United States depends on petroleum for nearly 95% of its transportation energy — about 10 million barrels per day of petroleum products are used to fuel light trucks and cars. More than half of our petroleum is imported, and this percentage is growing, which is why oil imports represent one of the largest components of the U.S. trade deficit.

Environment: Growing scientific evidence suggests that greenhouse gas emissions could contribute to a change in the earth's climate — and transportation, specifically the combustion of fossil fuels in vehicles, accounts for a large portion of greenhouse gases. A number of other pollutants in vehicle emissions are also harmful to the environment. The millions of vehicles on our roads burn thousands of gallons of petroleum every second, giving rise to a third of the country's air emissions.

FreedomCAR: A government-industry research partnership to develop hydrogen-powered fuel cell vehicles that use no petroleum and produce no harmful emissions. FreedomCAR also supports advanced technologies that can dramatically reduce oil consumption and the environmental impacts of conventional petroleum-dependent vehicles.

The 21st Century Truck Partnership: A partnership between DOE and the trucking industry to develop commercially viable technologies for heavy-duty trucks and buses that improve fuel efficiency, reduce emissions, enhance safety and performance, and lower operating costs.

Argonne's Goal

Argonne's goal is to **remove vehicles from energy and environmental equations**. Argonne researchers have undertaken studies in both basic and applied science to develop near- and long-term technologies that support two new U.S. Department of Energy (DOE) initiatives — FreedomCAR and The 21st Century Truck Partnership — aimed at reducing our dependence on foreign oil, cutting greenhouse gas emissions, and fueling our national economy (see sidebar).

Basic Research Highlights

X-Ray Engines: Researchers used x-rays at Argonne's Advanced Photon Source to penetrate gasoline and diesel sprays and reveal how to improve combustion in engines using fuel-injector systems. Argonne designed and constructed a pressurized spray chamber that allows scanning of the spray plume through the small x-ray-transparent windows (Figure 1) under pressures similar to those encountered in engine cylinders. The data collected will eventually help manufacturers build cleaner, more efficient fuel-injection systems.

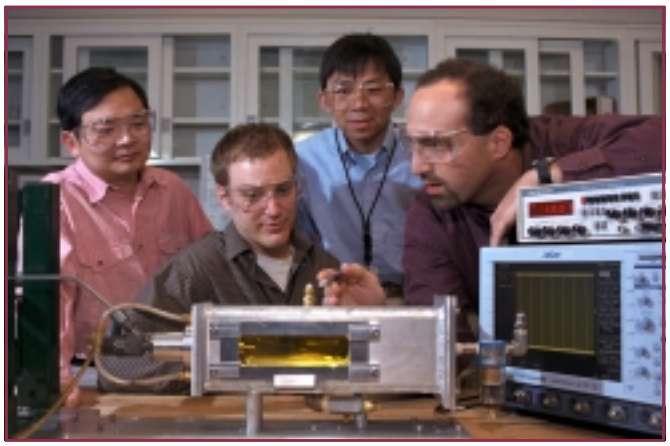

Figure 1. A team of Argonne scientists recently won the 2002 DOE National Laboratory Combustion and Emissions Control R&D Award for their groundbreaking work in examining fuel sprays.

Applied Research Highlights

Emissions Reduction: Argonne is developing new bifunctional catalytic systems that convert nitrogen oxides to environmentally friendly products under lean-burn conditions and enhance diesel engine performance.

Hybrid Vehicles: Argonne conducts emissions and energy-efficiency research, testing, and development for hybrid electric vehicles, sport-utility vehicles, and advanced technology vehicles. Our facilities (Figure 2) allow Argonne researchers to benchmark the most advanced powertrains for future cars and trucks.

Figure 2. Component, subsystem, and vehicle testing and development are supported at Argonne's state-of-the-art facilities.

Fuel Cells/Hydrogen:

- *Hydrogen production.* Argonne researchers are working to develop an economical thermochemical process that uses the next generation of nuclear reactors to provide a safe, pollution-free heat source for hydrogen manufacture.
- *Fuel reformer catalysts.* A reforming catalyst developed at Argonne — the key component of a fuel reformer that can efficiently convert gasoline, diesel fuel, natural gas, methanol, or ethanol into a hydrogen-rich fuel — won a coveted R&D 100 Award in 2001.
- *Modeling and analysis.* Argonne researchers use comprehensive analysis techniques to project the effects of fuel cell vehicles and other advanced transportation technologies on society and predict the influence of government policies on their development and use. Argonne's GREET model provides complete well-to-wheel evaluations of how energy and emissions considerations change when fuel cell vehicles use different fuels. Another Argonne-developed model, GCtool, lets designers "try out" different system configurations without the expense and delays of actually building numerous prototypes.

Facilities

Advanced Powertrain Research Facility
Locomotive Testing Facility
Fuel Cell Test Facility
Battery Testing Facility
4-Wheel-Drive Chassis Dynamometer Test Cell

Sponsor

U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy

Partners

Fuel Sprays
- Brigham Young University
- Cornell University
- Delphi Systems
- Johns Hopkins University
- Princeton University
- Robert Bosch Corp.
- State University of New York at Stony Brook

Advanced Vehicle Systems and Modeling
- DaimlerChrysler
- Ford Motor Company
- General Motors

Hydrogen Production
- General Electric
- Italian National Agency for New Technology, Energy & Environment
- Japan Nuclear Cycle and Development Institute
- Texas A&M University

Emissions Reduction
- Caterpillar
- Electromotive Division, General Motors
- Sierra

Reformer Catalysts
- Süd-Chemie, Inc.
- H2fuel
- Avista Labs

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